

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a porous film formed above a semiconductor substrate, the porous film having at least one burying concave selected from the group consisting of a trench and a hole;

5 a conductive barrier layer formed on the inner surface of the burying concave;

10 a conductive member buried in the burying concave with the conductive barrier layer interposed between the porous film and the conductive member; and

15 a mixed layer formed between the porous film and the conductive barrier layer, and containing a component of the porous film and a component of the conductive barrier layer.

2. A semiconductor device according to claim 1, wherein the mixed layer comprises a layer constituted with the porous film, and the same component as the conductive barrier layer existing open cells of the layer constituted with the porous film.

20 3. A semiconductor device according to claim 1, wherein an aspect ratio D/W of the depth D to the width W of the burying concave is 1.5 or more.

25 4. A semiconductor device according to claim 1, wherein the conductive barrier layer is made of at least one selected from the group consisting of TiSiN, TaN, WN, WSiN and TaAlN.

5. A semiconductor device according to claim 2,
wherein the concentration of the component of the
conductive barrier layer contained in the mixed layer
is high on the side of the conductive barrier layer and
5 is gradually lowered with increasing distance from the
conductive barrier layer, and the open cells of the
porous film on the side of the conductive barrier layer
are substantially closed by the same component as the
conductive barrier layer.

10 6. A semiconductor device according to claim 1,
wherein the mixed layer has a thickness not larger
than 30 nm.

7. A method of manufacturing a semiconductor
device, comprising:

15 forming at least two conductive barrier layers
having substantially the same component composition by
a thermal CVD method on the inner surface of at least
one burying concave selected from the group consisting
of a trench and a hole formed in a porous film formed
20 above a semiconductor substrate; and

burying a conductive member in the burying concave
having the conductive barrier layers formed therein;

25 wherein the pressure for the thermal CVD process
for forming the first conductive barrier layer is set
lower than the pressure for the thermal CVD process for
forming the other conductive barrier layer including
the second conductive barrier layer.

8. A method of manufacturing a semiconductor device according to claim 7, wherein an aspect ratio D/W of the depth D to the width W of the burying concave is 1.5 or more.

5 9. A method of manufacturing a semiconductor device according to claim 7, wherein the thermal CVD process for forming the first conductive barrier layer is carried out at a temperature of 300 to 370°C and a pressure of 0.4 to 0.8 Torr, and the thermal CVD 10 process for forming the other conductive barrier layer including the second conductive barrier layer is carried out at a temperature of 300 to 370°C and a pressure not lower than 1.0 Torr.

15 10. A method of manufacturing a semiconductor device according to claim 7, wherein the thermal CVD process for forming the first conductive barrier layer is carried out so that open cells of the porous film which lies in a region extending to a distance of not larger than 30 nm from the inner surface of the burying 20 concave is substantially closed by the same component as the conductive barrier layer.

11. A method of manufacturing a semiconductor device according to claim 7, wherein each of the thermal CVD processes is used a mixed gas, for 25 forming a conductive barrier layer consisting essentially of TiSiN, containing at least one titanium compound gas selected from the group

consisting of tetrakis(dimethylamino)titanium,
tetrakis(diethylamino)titanium, and $TiCl_4$, at least one
silicon compound gas selected from the group consisting
of SiH_4 and Si_2H_6 , and at least one nitrogen-containing
5 gas selected from the group consisting of NH_3 and N_2 .

12. A method of manufacturing a semiconductor
device according to claim 7, wherein the conductive
member is buried in the burying concave by forming
a conductive film on the conductive barrier layers
10 formed on the porous film including the burying concave
and then applying a chemical mechanical polishing
treatment to the conductive film.

13. A method of manufacturing a semiconductor
device according to claim 7, further comprising forming
15 an insulating protective film on the porous film,
the burying concave being formed in a laminated film
consisting of the porous film and the insulating
protective film.

14. A method of manufacturing a semiconductor
device, comprising:
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25 forming a first conductive barrier layer by
a plasma CVD process on the inner surface of at least
one burying concave selected from the group consisting
of a trench and a hole formed in a porous film formed
above a semiconductor substrate;

forming at least one second conductive barrier
layer by a thermal CVD process or an atomic layer

deposition on the inner surface of the burying concave having the first conductive barrier layer formed therein; and

5 burying a conductive member in the burying concave having the second conductive barrier layer formed therein.

10 15. The method of manufacturing a semiconductor device according to claim 14, wherein an aspect ratio D/W of the depth D to the width W of the burying concave is 1.5 or more.

15 16. The method of manufacturing a semiconductor device according to claim 14, wherein the thermal CVD process for forming the second conductive barrier layer is carried out at a temperature of 300 to 370°C and a pressure not lower than 1.0 Torr.

20 17. A method of manufacturing a semiconductor device according to claim 14, wherein the plasma CVD process for forming the first conductive barrier layer is carried out so that open cells of the porous film which lies in a region extending to a distance of not larger than 30 nm from the inner surface of the burying concave is substantially closed by the same component as the conductive barrier layer.

25 18. A method of manufacturing a semiconductor device according to claim 14, wherein the plasma CVD process and the thermal CVD process are used a mixed gas, for forming a conductive barrier layer

consisting essentially of TiSiN, containing at least one titanium compound gas selected from the group consisting of tetrakis(dimethylamino)titanium, tetrakis(diethylamino)titanium, and TiCl₄, at least one silicon compound gas selected from the group consisting of SiH₄ and Si₂H₆, and at least one nitrogen-containing gas selected from the group consisting of NH₃ and N₂, respectively.

10 19. A method of manufacturing a semiconductor device according to claim 14, wherein the conductive member is buried in the burying concave by forming a conductive film on the first and second conductive burrier layers formed on the porous film including the burying concave and then applying a chemical mechanical 15 polishing treatment to the conductive film.

20 20. A method of manufacturing a semiconductor device according to claim 14, further comprising forming an insulating protective film on the porous film, the burying concave being formed in a laminated film consisting of the porous film and the insulating protective film.